April 16, 1935. W. F. WINTER, JR 1,998,299

VAPOR ELECTRIC DEVICE

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Fig. 1.

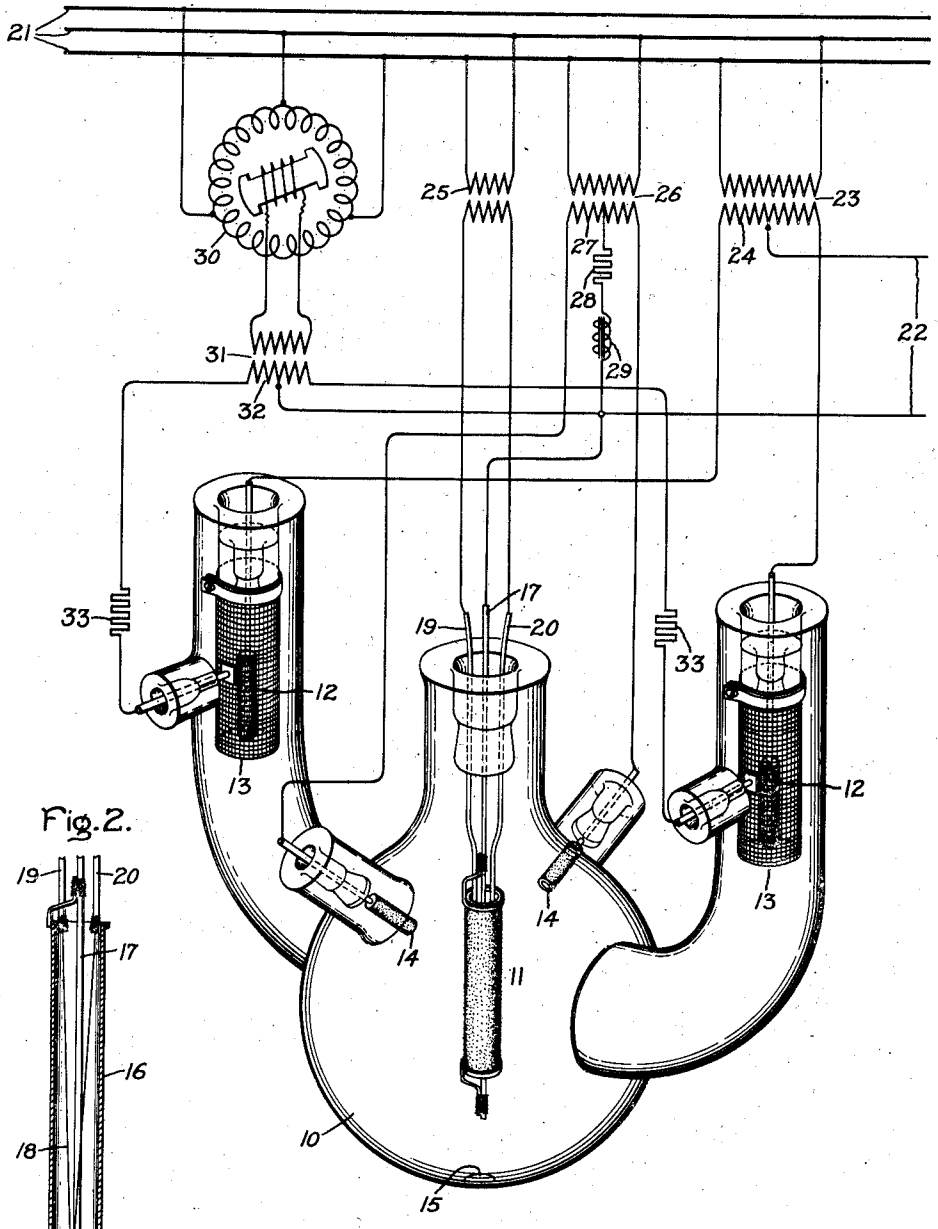


Fig. 2.

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VAPOR ELECTRIC DEVICE

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8 Claims. (Cl. 250—27)

My invention relates to vapor electric devices of the hot cathode type, and has for its principal object the provision of an improved vapor electric device wherein current is readily started between the heated cathode and the anode, or anodes, of the device.

In the operation of apparatus, such as the vapor electric rectifier, current is transmitted between a cathode and one or more anodes through an electric arc which carries a multitude of electrons and positive ions. The electrodes of the device are enclosed within a highly evacuated receptacle, which contains a small amount of mercury vapor, argon or the like. The cathode may be either a pool of mercury or a metallic member which is heated by current supplied from any suitable source. If the device is of the heated or hot cathode type and the receptacle is made of insulating material such as glass, difficulty in starting the arc between the cathode and anode is encountered due to the accumulation of a negative charge on the receptacle walls which act like a negatively charged grid. In accordance with my invention, this difficulty is avoided by the provision of means, such as auxiliary electrodes, whereby the negative charge is removed from the receptacle walls and ready starting of the arc is made possible.

My invention will be better understood from the following description when considered in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring to the drawing, Fig. 1 illustrates an apparatus wherein my invention has been embodied; and Fig. 2 illustrates certain details in the construction of the hot cathode device.

This device includes a container 10 of insulating material within which are enclosed a cathode 11, anodes 12, grids 13, and auxiliary discharging anodes 14. The container 10 is highly evacuated except for a small amount of gas, such as argon or the like. Mercury vapor produced by a drop of mercury 15 in the bottom of the vessel may also be used.

As shown more clearly in Fig. 2, the cathode 11 may be an oxide coated cylindrical member 16 which is supported by a conductor 17 and has its temperature controlled by a heating element 18 connected at its top to the leads 19 and 20 and at its bottom to the support 17.

It is known by those skilled in the art that the device may be used in the various types of power converting systems. Fig. 1 illustrates a system wherein power is transmitted between an alternating current circuit 21 and a direct current circuit 22 through means including a transformer 23 and the vapor electric device.

The main transformer 23 includes a secondary winding 24 provided with a mid tap which forms one terminal of the direct current circuit 22 and with end terminals which are connected to the anodes 12. The other terminal of the direct current circuit 22 is connected to the cathode 16 through the conductor 17.

Heating current is supplied to the heater 18 through a transformer 25, and potential is applied to the auxiliary charge dissipating electrodes 14 through a transformer 26 including a secondary winding 27 which has its end terminals connected to these auxiliary anodes and is provided with a mid tap connected to the cathode 16 through a resistor 28 and a reactor 29.

An alternating potential of variable phase is applied to the grids 13 through a phase shifter 30 and a transformer 31 which includes a secondary winding 32 provided with a mid tap connected to the cathode 16 and with end terminals connected to the grids 13 through current limiting resistors 33.

With these connections, the voltage of the direct current circuit 22 is readily controlled by adjustment of the phase shifter 30 which determines the point in each half cycle of anode potential at which current may start between the cathode 11 and the anodes 12.

Before this current can start, however, it is essential that the negative charge on the wall of the container 10 be dissipated. This result is produced by the charge dissipating electrodes 14 which are mounted in proximity to the cathode and take very little power, a current of about 0.1 ampere being sufficient to produce enough positive ions to neutralize the negative charge on the wall of the receptacle.

While the auxiliary anodes 14 have been illustrated as connected to the alternating current circuit 21, it should be understood that they may be connected to the main anodes or to a supplementary circuit depending on the purposes for which the device is used. As a result of the neutralizing effect of the positive ions produced by the small discharge of the auxiliary anodes, the arc between the cathode and the main anodes readily starts when the potential of the grids becomes positive. The auxiliary anodes are of course also useful during the operation of the device in order that the grids may be able to control the starting of the arc. Otherwise, since the arc is extinguished between each half cycle

the negative charges on the glass would reappear, and prevent starting.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. A vapor electric device including a solid cathode of the heatable type, an anode and a grid mounted to control the starting of current between said cathode and anode, a receptacle of insulating material enclosing said grid and said cathode and anode, said receptacle having a wall which tends to collect a negative charge due to potentials impressed on said anode tending to cause current flow therefrom, said negative charge being sufficient to prevent initiation of said current flow by said grid, and means for dissipating said charge including an auxiliary electrode mounted within the receptacle.

2. In a system for the transfer of electric energy, a vapor electric device including a solid cathode of the heatable type and an anode enclosed within a receptacle containing an ionizable medium and having a wall, means to impress potentials on said anode tending to cause current flow therefrom, said means operating to supply a negative charge to said wall preventing initiation of said current flow, and means for dissipating said charge comprising an auxiliary electrode mounted within the receptacle and means to cause a discharge current of the order of 0.1 ampere to flow between said auxiliary electrode and said cathode.

3. In a system for the transfer of electric energy, a vapor electric device including a solid cathode of the heatable type, an anode, a grid, and a receptacle of insulating material containing an ionizable medium, said receptacle enclosing said grid, anode and cathode, means to impress potentials on said anode tending to cause current flow therefrom, means to impress potentials on said grid for initiating said current flow, said first-named means operating to impress on the wall of said receptacle a negative charge preventing said initiation of the current flow, and means for dissipating said negative charge comprising an auxiliary electrode and means for causing a discharge current of the order of 0.1 ampere to flow between said auxiliary electrode and said cathode.

4. In a system for the transfer of electric energy, a device including a solid cathode of the heatable type and an anode enclosed within a receptacle containing an ionizable medium and having a wall, means to impress potentials on said anode tending to cause current to flow therefrom, said means tending to impress a negative charge on said wall preventing initiation of said current flow, means for heating said cathode, and means for maintaining within said receptacle sufficient positive ions to prevent the wall becoming negatively charged sufficiently to prevent initiation of said current flow, said last-named means comprising an auxiliary anode mounted within the receptacle and means to cause a discharge current of the order of 0.1 ampere to flow between said auxiliary anode and said cathode.

5. In an electric system for transferring energy between two circuits, a vapor electric device including a solid cathode of the heatable type and an anode enclosed within a receptacle containing a small quantity of vaporizable material adapted to provide an ionizing medium in said receptacle, said receptacle having a wall, means to impress potentials on said anode tending to cause current flow therefrom, said means operating to supply a negative charge to said wall preventing initiation of said current flow, said cathode being mounted closely adjacent to said vaporizable material whereby a higher pressure of said ionizable medium is produced in the region of the cathode than in the region of the anode, and means for dissipating said charge comprising an auxiliary electrode mounted within the receptacle and means to cause a discharge current of the order of 0.1 ampere to flow between said auxiliary electrode and said cathode.

6. In an electric system for transferring energy between two circuits, a vapor electric device including a solid cathode of the heatable type and an anode enclosed within a receptacle containing mercury vapor and a small quantity of liquid mercury, said receptacle having a wall, means to impress potentials on said anode tending to cause current flow therefrom, said means operating to supply a negative charge to said wall preventing initiation of said current flow, said cathode being mounted substantially closer to said liquid mercury than to said anode whereby the mercury vapor pressure in the region adjacent said cathode is higher than in the region adjacent said anode, and means for neutralizing said charge comprising an auxiliary electrode mounted within the receptacle and means to impress a positive charge upon said auxiliary electrode sufficient to neutralize said negative charge.

7. In an electric system, a vapor electric device including a cathode and an anode enclosed within a receptacle, said device being of the type which operates without holding anodes for maintaining the discharge between said anode and cathode after initiation of said discharge, said receptacle having a wall which collects a negative charge preventing said initiation of said discharge, an auxiliary electrode mounted within said receptacle, and means to impress a positive potential upon said auxiliary electrode sufficient to dissipate said negative charge to such extent that said discharge between anode and cathode may be initiated.

8. In an electric system, a vapor electric device including a cathode and an anode enclosed within a receptacle, said device being of the type which operates without holding anodes to maintain the discharge between said anode and cathode after initiation of said discharge, said receptacle having a wall which collects a negative charge preventing initiation of said discharge, an auxiliary electrode mounted within said receptacle, and means to cause a discharge current to flow between said auxiliary electrode and said cathode to produce sufficient positive ions within said receptacle to neutralize said negative charge.

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